Proposals to Relax Limitations on FITS Keywords

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1 To Increase the Allowed Length of Keyword Names

1.1 Definition

A new type of 'free-format' FITS keyword is defined in which the '=␣' 'value indicator' that separates the keyword name from the keyword value (currently required to be in bytes 9 and 10 of the keyword record) is allowed anywhere beyond byte 9 of the 80-byte keyword record. In principle this could allow keyword names up to 77 characters long (leaving only 1 byte for the value field), however it is recommended that keyword names be limited to 50 characters in order to leave sufficient room for a reasonable range of integer and floating-point keyword values.

These new long keyword names inherit the same format restrictions that apply to the current 8-character names. The names must be left-justified (starting in byte 1 of the keyword record). In the absence of other conventions that could possibly extend the allowed character set, the only characters that are allowed in the keyword name are the digits 0 through 9, the uppercase Latin alphabetic characters 'A' through 'Z', and the underscore and the hyphen characters. Non-significant space characters may occur between the end of the keyword name and the '=␣' value indicator.

1.2 Examples

The following keyword records conform to this convention:

```
00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
MY_STRING_VALUED_KEYWORD = 'Mary had a little lamb'  / string value
MY_LOGICAL_KEYWORD=     T   / this keyword has a logical value
MAXIMUM_ALLOWED_EXPOSURE_TIME = 3600 / [s]  time in units of seconds
FLUX_POLYNOMIAL_COEFFICIENT1 =  4500.  /  These are a series of
FLUX_POLYNOMIAL_COEFFICIENT2 =  11.0  /  indexed keywords which have
FLUX_POLYNOMIAL_COEFFICIENT3 =  0.015  / the form KEYWORDn where
FLUX_POLYNOMIAL_COEFFICIENT4 =  0.000078 /  'n' is the index number
```

The following keyword records do not conform to this convention (but they are still valid FITS keyword records):

```
00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
BACKGROUND FLUX VALUE = 0.01 / Embedded spaces are not allowed in name
INTEGRATED_Flux = 0.01 / Lowercase letters not allowed in name
BATTERY_CHARGE% = 99.0 / Illegal '%' character in name
USER_ADDRESS(STATE) = 'Texas'  / Illegal '(' character in name
OBSERVATORY_NAME ='NOAO' / No space character following the equals sign
CAMERA_MICRO_SHUTTER_START_LATENCY_TIME_COEFFICIENT = 17 / '=' is in byte 53
```

1.3 Discussion

These new free-format keyword records do conform to the requirements of the current FITS Standard. Since these keyword records do not have the '=␣' value indicator in bytes 9-10 any software that does not support this new convention should interpret these keyword records as commentary-type keywords without any value field (similar to the `COMMENT` and `HISTORY` keywords). This is the case even for the examples, shown above, that do not correctly conform to this new long keyword name convention.

Limiting the length of the keyword name to 50 characters leaves a minimum of 28 characters in the keyword record for the value and optional comment fields. This is sufficient to express the value of the largest possible 64-bit integer (20 characters, including the plus or minus sign) or a floating point number with 16 digits of precision expressed in exponential notation with a 3-digit exponent (24 characters).

By default, the new long keyword names are required to conform to the same rules that govern the existing FITS keyword names (except for their length). However, this does not preclude new conventions that might extend the allowed set of characters in the names.

2 To Extend the Allowed Set of Characters in Keyword Names

2.1 Definition

In addition to the digits 0 through 9, the uppercase Latin alphabetic characters 'A' through 'Z', and the underscore and the hyphen characters, the following set of ASCII characters are allowed in FITS keyword names: [To Be Determined]

It is To Be Determined whether these new characters shall be restricted so that they cannot occur within characters 1 through 8 of the keyword name.

2.2 Discussion

During the discussion of Proposal 1 on allowing long keyword names, it may also be an opportune time to consider extending the allowed character set in keyword names. This might include lower case letters (although the case might be considered non-significant), and other non-alphanumeric

characters such as '*', '&' or '%'. Also, the '.' (period or full-stop character) might be useful for representing hierarchical keywords.

Consideration should also be given to whether these new characters are allowed within the first 8 characters of the keyword name. Doing so could have a larger impact on existing FITS software.

3 To Increase the Allowed Length of String-valued Keywords

3.1 Definition

This long string-valued keyword proposal may be used to assign a character string value to a FITS keyword that is longer than can be expressed on a single 80-character keyword record. The long character string value is divided into multiple substrings, each of which is a maximum of 67 characters in length. A 'back slash' ("\") continuation character is appended to all but the last substring, then all the substrings are enclosed within single quote characters and written to a sequence of 80-byte keyword records. The first keyword record is constructed using the actual keyword name; the keyword names on all the subsequent continuation keyword records have an underscore character followed by an integer sequence number appended to that same name. The sequence number on the first continued keyword record must be the number 1 (without any leading zeros) and the sequence number is incremented by 1 on each subsequent keyword. It is recommended, but not required, that these keywords appear in order in the FITS header without any intervening keyword records.

The first keyword in the sequence has the '=␣' 'value indicator' between the keyword name and the value string. All the subsequent keyword records do not have the value indicator: the keyword name and the quoted substring are simply separated by one or more space characters. Thus, under the current rules of the FITS Standard, the continued keyword records do not formally contain a keyword value.

3.2 Examples

The following keyword records conform to this convention:

```
00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
ABSTRACT= 'Fifteen spirals are now available for which the sense of the spiral\'
ABSTRACT_1 ' pattern and the sense of the spectrographic rotation are known an\'
ABSTRACT_2 'd in which there is conspicuous dissymmetry of obscuration.'
```

Note that it is not required that each substring completely fill each keyword record. In principle each keyword record may also contain a comment field, as shown below.

```
00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
ABSTRACT= 'Fifteen spirals are now available \'    / Article by E. Hubble
```

```
ABSTRACT_1 'for which the sense of the spiral \'  / published in 1943
ABSTRACT_2 'pattern and the sense of the spectrographic \'  / in the Ap.J.
ABSTRACT_3 'rotation are known and in which there is \'
ABSTRACT_4 'conspicuous dissymmetry of obscuration.'
```

3.3 Discussion

The main advantage of this proposal over the existing HEASARC convention for representing long string values is that this proposal explicitly defines the order of the continued keywords and hence is not affected if the order of the keywords in the FITS header is changed.

The back slash ("\") continuation character serves as a flag to the keyword reading software that this this keyword is probably continued on another keyword record. Other characters, such as the '&', could serve this purpose just as well. The continuation character is appended to the character string itself (rather than perhaps outside of the string in the 80th character of the keyword record) to make the continuation character more prominent to both software and to humans. Note that if a keyword string value ends with the continuation character, but there is no valid continued keyword record in the FITS header, then that continuation character should be considered as an actual part of the value string.

The lack of the '=␣' value indicator in the continued keyword records serves to help insulate them from corruption by existing software that does not support this conventions. Since these keyword record do not formally contain a value according to the current FITS Standard, it is arguably less likely that existing software will attempt do anything with these keyword records. Such software should treat these keywords in the same way as COMMENT or HISTORY keywords that also do not have a value,